ELEC 475/575 Syllabus

ELEC 475/575 - Learning from Sensor Data
Syllabus 2016

Overview
The first half of this course develops the basic machine learning tools for signals images, and other data acquired from sensors. Tools covered include principal components analysis, regression, support vector machines, neural networks, and deep learning. The second half of this course overviews a number of applications of sensor data science in neuroscience, image and video processing, and machine vision. *Please note this course is listed as ELEC 475 for undergraduate students and ELEC 575 for graduate students.*

Prerequisites
- ELEC 301 Signals and Systems
- Linear Algebra Fundamentals - We will emphasize a linear algebraic approach over a probabilistic approach in this course. Graduate students (especially) should endeavor to master both perspectives.
- Programming Experience - MATLAB or Python (preferred).

Grading
25% - Midterm Exam
25% - Final Exam
15% - Homework
13% - Group Competition 1
13% - Group Competition 2
9% - Notebook
Classroom participation (up to 5% bonus)
Undergraduates and graduates will be graded on separate curves.

ALL assignments must be completed, or you will receive an incomplete for the course.

Homework Policy
Homework will be posted each week on Piazza and is due by 5pm the following Friday. After the due date, 0% credit will be issued. However, all assignments must be turned in, _or an incomplete grade will be assigned. Homework, tests, and solutions from previous offerings of this course are off limits, under the honor code.

Class Participation
Up to a 5% bonus toward your final grade will be assessed based on (1) your attendance, (2) your participation in class, which includes posing and answering questions, (3) completing group activities during class, and (4) not using your laptop or smartphone during class.

Class Notebook
Each class, fill out in a notebook or piece of paper (that you save) which records the *Date, Theme of the lecture,* and *Unclear points in the lecture*. Please also communicate "unclear points" via a post (even anonymous) to Piazza immediately after class. You will hand in your complete notebook on last day of class.

Study Groups
Students are required to organize a regular _(at least weekly) study group. Students may discuss and work on the homework assignment together; however, students must always submit their own work. Group work should not substitute for study on your own; at test time, only a pencil will accompany you.

Testing Policy
Unless otherwise noted on the test instructions, all tests are timed, closed notes/books, and must be taken on your own (i.e., no collaboration with anyone else). Homework, tests, and solutions from previous offerings of this course are *off limits,* under the honor code.

Honor Code
Homework, tests, and solutions from previous offerings of this course are off_ limits, under the honor code.

Group Competitions
In the 2nd half of the semester, students will form groups of 3-4 members and participate in two competitions that apply the concepts they have learned in the class. In each competition, which will be set up using Kaggle, groups will be given a task and a training data set. Based on this information, groups will develop machine learning algorithms to perform well on the test data set. The grade on each competition will be determined by (1) performance on test data set, (2) depth of exploration of the relevant machine learning concepts, and (3) quality of the competition report.

Students with disabilities
Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities should also contact Disabled Student Services in the Ley Student Center.

Course Topics

- What is machine learning, data mining, and data science?
- Linear algebra review
- Optimization
- Unsupervised learning
  - Principal components analysis
  - k-means
- Supervised learning – Regression
  - Least squares
  - Ridge regression
  - Lasso
- Supervised learning – Classification
  - Logistic regression
  - Support vector machines
  - Features
- Kernel methods
- Decision trees
- Special topics in machine learning
  - Machine vision, image processing
  - Deep learning
  - Neuroscience
  - Neuroengineering
  - Personalized healthcare
  - Mood sensing

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